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13. ABSTRACT This Procedure describes test methodology and testing techniques necessary to determine the technical performance and safety characteristics of ground support service aviation equipment and associated accessories as described in the Materiel Need (MN), and to determine the item suitability for service tests.		

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Materiel Test Procedure 7-2-055  
General Equipment Test Activity

US ARMY TEST AND EVALUATION COMMAND  
COMMODITY ENGINEERING TEST PROCEDURE

GROUND SUPPORT SERVICE EQUIPMENT (AVIATION)

OBJECTIVE

This document provides test methodology and testing techniques necessary to determine the technical performance and safety characteristics of ground support service aviation equipment and associated accessories as described in the Materiel Need (MN), and to determine the suitability of the item for service tests.

2.

BACKGROUND

Army airfields and heliports presently vary from small unimproved areas, which meet minimum requirements for the operation of fixed wing aircraft or helicopters, to completely organized and equipped airfields and heliports. The following FM-1-100 defined standards of airfield/heliport construction prevail:

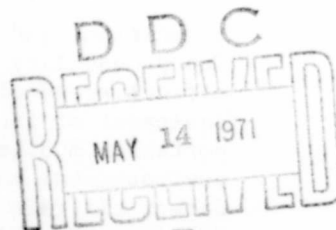
a. Pioneer: That Army airfield or heliport which represents the lowest standard of construction which can be used only under favorable operating conditions.

b. Hasty: That Army airfield or heliport which is built to provide a substandard but operable margin of safety. This type of field permits reasonably safe and efficient operation except in prolonged adverse weather.

c. Deliberate: That Army airfield or heliport which is constructed according to established standards of safety and efficiency. Generally, the installation includes facilities for refueling and for the performance of some aircraft maintenance.

The opportunity to employ Army Aircraft from these types of airfields to the best advantage may come suddenly and require that supporting aviation units be immediately available and continually responsive to the area commander. In practice, however, there is seldom enough aviation support to satisfy all justifiable demands. Therefore, the available support must be utilized in an optimum manner through management techniques and rapid aircraft turn-around through effective replenishment of aircraft POL,

\*This MTP is intended to be used as a basic guide in preparing actual test plans for the subject equipment. Specific criteria and test procedures must be determined only after careful appraisal of pertinent Materiel Need (MN) and any other applicable documents.



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ammunition, and repair parts, and accomplishment of minor maintenance. The probability of the latter being adequate is largely a function of the effectiveness of available ground support equipment. Army ground support equipment of the future must be entirely dedicated to aircraft service, be portable, mobile, air/surface transportable, and readily adaptable to various environmental conditions. Principally, Army ground support equipment of the direct aircraft (flight line) service type will be required to provide the following functions:

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- 1) Electrical Energy: This service function is required for the starting of aircraft engines, testing of aircraft electrical components, operating small tools, and for charging aircraft batteries. Equipment providing these functions will be self-contained, mobile, diesel-or gasoline-driven. These items are generally referred to as auxiliary power units (APU's).
- 2) Low and High Pressure Air: A portable, mobile, and self-contained low pressure air compressor is required for aircraft tire inflation, for small tools, and to furnish low pressure air for other pneumatic equipment. In addition, high pressure air compressors are required for servicing aircraft gear shock struts, hydraulic accumulators, and other high pressure applications.
- 3) Heated Air: Heated air, by steady flow, is required in certain climatic areas for preheating engine(s), battery compartment(s), and crew compartment(s). Also, these heaters will be required to provide heat for aircraft maintenance shelters, for defrosting wings or applying heat under wing covers, and to keep aircraft engines warm during long idle periods. As with other GSE, the heater is required to be portable, mobile, self-contained, and safe to operate.

3.

### REQUIRED EQUIPMENT

3.1

#### MAINTENANCE AND INSPECTION FACILITIES

3.2

#### INSTRUMENTATION AND REQUIRED MATERIALS

- a. 100 foot tape measure.
- b. Still camera, film, flashbulbs.
- c. Motion picture camera and film.
- d. Weighing scales.
- e. Ship simulator for roll and pitch tests.
- f. Reference standards for instrument calibration.
- g. Flow nozzle arrangement per Figure 2 "A" of ASME Power Test Code for Displacement Compressors, Vacuum Pumps and blowers (PTC 9) and sections 4-10 through 4-15 and 4-29 of PTC-9.
- h. Long radius, low ratio flow nozzle described in Power Test Code Supplements on Instruments and Apparatus (I&A) Part 5, Chapter 4, and meeting the following requirements

of PTC-9 for the air capacity being measured, with the inlet air at 68°F. and 14.7 psia, having a relative humidity of 36 percent.

- i. Mercurial barometer fitted with a vernier suitable for reading to the nearest 0.002 part of an inch, and equipped with an attached thermometer for indicating the instrument temperature.
- j. Lubricating oil for compressor per MIL-L-17672, symbol 2110TH.
- k. Diesel engine fuel oil per VV-F-800.
- l. Gasoline fuel per MIL-G-3056.
- m. Antifreeze compound per G-A-548.
- n. Gasoline engine lubricating oil per MIL-L-2104 and MIL-L-10295.
- o. Tire pressure gauge. -
- p. Stop watch.
- q. Tension dynamometer and associated steel cable or chain.
- r. Greases per MIL-G-23827 and MIL-G-10924
- s. Automatic device to shut off compressor air flow for 1 minute during a 5 minute ON-OFF cycle.
- t. Protractor.
- u. Power generator maintenance kit.
- v. Flexible oil line or copper tubing.
- w. Regulating valves.
- x. Brass fittings.
- y. Vibration measuring set.
- z. Electronic counter and tachometer generator.
- aa. EMI instruments and antennas per MIL-STD-461.
- ab. Thermometers liquid in glass, degrees F.
- ac. Sound level meter.
- ad. Octave band analyzer.
- ae. AC and DC voltmeters (0-500v).
- af. Wattmeters (one-and three-phase).
- ag. AC and DC ammeters (sufficient in range to measure 125 percent full load current of generator).
- ah. Frequency meter.
- ai. Power factor meters (one- and three-phase).
- aj. Waveform analyzer.
- ak. Single-track oscillograph.
- al. Switches, as required.
- am. Stop watch.
- an. Oil pressure gauge.
- ao. X, y recorder(s).
- ap. Manometer.
- aq. Accelerometer(s).
- ar. Thermocouples and associated indicating devices.
- as. Meter probes.
- at. Marine simulation facility/device.

- a. High temperature test chamber.
- b. Low temperature test chamber.
- c. Altitude test chamber.
- d. Sand and dust chamber
- e. Rain test chamber.

4.

#### REFERENCES

- A. Army Regulation 70-38 Research and Development: Research, Development, Test and Evaluation of Materiel for Extreme Conditions of Environment.
- B. USATECOM Regulation 385-6 Safety Release.
- C. USATECOM Regulation 70-23 Research and Development: Equipment Performance Reports (EPRs).
- D. USATECOM Regulation 700-1 Quality Assurance.
- E. USACEA Document Human Factors Evaluation Data for General Equipment (HEDGE).
- F. FED-STD-101 Preservation, Packaging, and Packing Materials, Test Procedures.
- G. MIL-STD-1186 Cushioning, Anchoring, Bracing, Blocking, and Waterproofing; with Appropriate Test Methods.
- H. MIL-STD-461 Electromagnetic Interference Characteristics Requirements for Equipment.
- I. MIL-STD-462 Electromagnetic Interference Characteristics Measurements of.
- J. MIL-STD-463 Definitions and System of Units, Electromagnetic Interference Technology.
- K. MIL-STD-129 Marking for Shipment and Storage.
- L. MIL-STD-130 Identification Marking of US Military Property.
- M. MIL-STD-209 Slings, Eyes and Attachments for Lifting and Tying Down Military Equipment.
- N. MIL-STD-705A Military Standard Generator Sets, Engine-Driven, Methods of Test and Instructions.
- O. MIL-STD-810B Environmental Test Methods.
- P. MIL-E-11276 Engines, Diesel: Industrial, Medium-and High-Speed, General Specification for.
- Q. MIL-E-11725, Engines, Gasoline, Industrial Type, General Specification for.
- R. MIL-T-46729 Tire, Pneumatic, for Military Ground Vehicles.
- S. MIL-G-3056 Gasoline, Automotive, Combat.
- T. MIL-L-10295 Lubricating Oil, Internal Combustion Engine, Sub-Zero
- U. MIL-L-17672 Lubricating Oil, Hydraulic and Light Turbine, Non-Corrosive.
- V. MIL-C-26805 Compressor Units, Air, General Requirements for.
- W. MIL-L-2104 Lubricating Oil, Internal Combustion Engine, Heavy Duty.

- X. MIL-S-8512 Support Equipment, Aeronautical, Special, General Specification for the Design of.
- Y. MIL-M-8090 Mobility Requirements, Ground Support Equipment, General Specification for.
- Z. MIL-C-6021 Castings, Classification and Inspection of (Aeronautical Applications).
- AA. MIL-G-8402 Gauges Pressure, Dial Indicating General Specification for.
- AB. MIL-M-16034 Meters Electrical-Indicating (Switchboard and Portable Types.)
- AC. MIL-E-4970 Environmental Testing, Ground Support Equipment, General Specification for.
- AD. O-A-548 Antifreeze, Ethylene Glycol, Inhibited.
- AE. VV-F-800 Fuel Oil, Diesel.
- AF. FED-STD-595 Colors.
- AG. MTP 10-2-500 Physical Characteristics.
- AH. MTP 2-2-502 Inspection (Automotive).
- AI. MTP 10-2-501 Operator Training and Familiarization.
- AJ. MTP 10-2-507 Maintenance Evaluation.
- AK. MTP 2-2-505 Preliminary Operation.
- AL. MTP 2-2-508 Safety Evaluation (Automotive).
- AM. MTP 2-4-001 Desert Environmental Test of Wheeled and Tracked Vehicles
- AN. MTP 2-4-002 Arctic Environmental Test of Wheeled and Tracked Vehicles.
- AO. MTP 2-4-003 Tropic Environmental Test of Wheeled and Tracked Vehicles.
- AP. MTP 7-2-509 Air Drop Capability of Materiel.
- AQ. MTP 7-2-510 Engineering Testing of Air Drop System and Components.
- AR. MTP 2-2-800 Center of Gravity.
- AS. MTP 2-2-700 Laboratory Test of Reciprocating Internal Combustion Engines.
- AT. MTP 2-2-704 Tires.
- AU. MTP 2-2-614 Toxic Fumes.
- AV. MTP 2-2-703 Laboratory Tests of Power Train Components.
- AW. MTP 10-2-071, Duct-Type Heaters.
- AX. MTP 9-2-155 Electrical Motors.
- AY. MTP 9-2-166 Air Compressors.
- AZ. MTP 9-2-286 Power Generators.
- BA. MTP 2-2-650 Cold Starting and Warm-Up
- BB. MTP 7-2-105 Tractor, Wheeled, Aircraft, Towing
- BC. MTP 2-2-613 Broadband Radio Interference Tests of Vehicles and Electrical Equipment.
- BD. TM 55-405-8 Army Aviation Maintenance Engineering Manual Ground Support Equipment.
- BE. FM-1-100 Army Aviation Utilization.
- BF. American Society of Mechanical Engineers. Power Test Code; Displacement Compressors, Vacuum Pumps, and Blowers (PTC 9-1954) and Power Test Code Supplements on Instruments and Apparatus (I&A).

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5. SCOPE

5.1 SUMMARY

This procedure describes the preparation for and methods of evaluating the technical characteristics of aviation ground support service equipment and their suitability for service testing. The required tests are summarized as follows:

a. Preparation for Test - A determination of the condition and physical characteristics of the test item upon arrival. Also, to ensure that the test item is complete and functionally operational, and to provide operator training and familiarization procedures.

b. Ground Blower Heater Performance Tests-A series of tests for determining the technical performance characteristics of the test under standard ambient conditions.

c. Portable Ground Support Air Compressor Tests-A series of tests for determining the technical performance characteristics of the test item under standard ambient conditions.

d. Auxiliary Power Unit Tests-A series of tests for determining the technical performance characteristics of the test item under standard ambient conditions.

e. Operation in Tilted Positions Test - A determination of all test item types ability to function as intended when compelled to operate on surfaces which are not level.

f. Endurance Tests - A series of tests which subjects each test item type to extended operations for the purpose of determining overall test item durability and data useful for predicting test item reliability.

g. Self-Propelled Ground Support Equipment Mobility Tests - A series of tests for determining test item turning radius, ability to operate over paved, unimproved roads, and cross country, and other characteristics of mobility.

h. Towed or Manually Propelled Ground Support Equipment Mobility Tests - A series of tests for the determination of the mobility characteristics of ground support service equipment over simulated airfields of various types while being towed or manually propelled.

i. Broadband Radio Interference Tests - A series of tests for determining the radiation characteristics within that portion of the electromagnetic spectrum reserved for radio communications and surveillance by the Army.



j. Vibration and Shock Tests - A series of tests for determining test item ability to operate as intended during and following subjection to vibrations and shocks of a nature common to the environment of ultimate usage.

k. Climatic Extremes Tests - A series of tests provided as options for those equipments required for operation under desert, arctic, or tropic environmental conditions.

l. Intermediate Climatic Tests - A series of tests including rain, low and high temperature, and sand and dust, simulating the extremes of the intermediate climate as defined by AR 70-38.

m. Transportability - An evaluation to determine the ability of the test item to withstand the forces which it will experience during normal handling and transportation.

n. Maintenance and Reliability Evaluation - An evaluation to determine and appraise the maintenance characteristics and requirements of the drier, a verification and appraisal of malfunctions, an evaluation of the publications associated with the drier and other common and special support elements (maintenance test package), an appraisal of the drier design for maintainability (AMCP 706-134: accessibility, ease of maintenance, standardization, and interchangeability), an evaluation of component and system durability and reliability, and the calculation of indicators which express the effects of the preceding aspects.

o. Safety - An evaluation to determine the safety characteristics and possible hazards of the test item.

p. Human Factors Evaluation - An evaluation to determine the adequacy of the design and performance characteristics of the test item and associated equipment in terms of conformance to accepted human factors engineering design criteria.

q. Value Analysis - An evaluation directed at analyzing the primary function and features of the test item for the purpose of reducing the cost of the test item without compromising performance and safety characteristics.

r. Quality Assurance - A review to determine and evaluate defects in material and workmanship.

## 5.2 LIMITATIONS

The technical performance tests of this document, 6.2.1, 6.2.2, and 6.2.3 do not provide coverage for all types of aviation ground support equipment due to the large differences in physical principles involved. Other tests of this document, however, will prove applicable to all known types of aviation ground support equipment.

## 6. PROCEDURES

### 6.1 PREPARATION FOR TEST

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6.1.1 Initial Inspection

Upon receipt of the test item at the test site, perform applicable procedures of MTP 10-2-500 and the following:

a. Visually inspect the packaged test item. Record the following:

- 1) Evidence of damage incurred during transport or storage.
- 2) Exterior identification markings not in accordance with MIL-STD-129 or other governing documents.

b. Unpack and remove all traces of protective transport/storage materials. When this has been accomplished, visually inspect the test item. Record evidence of the following:

- 1) Interior marking(s) of shipment not in accordance with MIL-STD-129 or other governing documents.
- 2) Defects in test item materials and construction, treatment and finish, and/or workmanship.
- 3) Engine(s) not prepared for storage as specified by MIL-E-10062.

6.1.2 Inventory Check

a. Conduct an inventory against the Basic Issue Items List (BIIL). Record evidence of the following:

- 1) Missing maintenance literature or draft technical manuals.
- 2) Shortages in repair parts, accessories, or tools.
- 3) Missing kits.

b. Submit an Equipment Performance Report (EPR) for each noted shortage or discrepancy.

6.1.3 Inspection and Preliminary Operation

a. Perform periodic inspection(s) and maintenance as required by:

- 1) Test item draft technical manual (all test item types).
- 2) Applicable procedures of MTP 2-2-502 (self-propelled test item types).

b. Establish that the actual test item serial number and engine identification number match those numbers which appear on records accompanying the test item(s).

c. Read the test item running-time meter of self-propelled test items; if the total elapsed operating time is less than four hours, or less than an otherwise specified elapsed time, subject the test item to the break-in procedures of MTP 2-2-505.

d. Break-in generator, compressor, or fan drive engines in accordance with draft technical manual instructions.

e. Verify that test item fuel, lubrication, and coolant meets requirements of the following governing document, unless otherwise specified.

<u>Fuel, Lubricant, or Coolant</u>	<u>Specification</u>
Compressor lubricating oil (for ambient temperatures from 120°F. to minus 25°F.)	MIL-L-17672, symbol 2110TH.
Diesel engine fuel	VV-F-800
Gasoline engine fuel	MIL-G-3056, type II
Diesel or gasoline engine lubricant for 0°F. and higher ambient temps.	MIL-L-2104
Diesel or gasoline engine lubricant for subzero ambient temps.	MIL-L-10295
Antifreeze for water cooling system.	O-A-548

#### 6.1.4

##### Component Pre-Tests

Evaluate the performance and endurance of test item major and critical components and establish the suitability of testing the test item as a system; proceed as follows:

a. Reciprocating Internal Combustion Engine Tests - Subject the test item prime mover engine and/or accessory drive engine type(s) to the procedures of MTP 2-2-700 and the appropriate criteria of MIL-E-11275 or MIL-E-11276.

b. Power Train Component Tests - Subject power train components (clutch, transmission, drive shaft, axles, and brakes, as applicable) to the procedures of MTP 2-2-703.

c. Exhaust System Tests - Subject test item exhaust system to the procedures of MTP 2-2-614.

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d. Center of Gravity Determination - Determine the vertical and horizontal center of gravity by utilization of applicable procedures of MTP 2-2-800.

e. Tire Tests - Subject test item tire type (s) to the procedures of MTP 2-2-704 and appropriate criteria of MIL-T-46729.

f. Castings Tests - Subject test item cast parts to appropriate quality assurance tests of MIL-C-6021.

g. Color Test - Company test item exterior color to requirements of FED-STD-595 which relate to flight line and hangar equipment.

h. Electrical Instrument Tests - Subject instrument panel or control panel indicating instruments (electrical indicators) to appropriate requirements of MIL-M-10304.

i. Electric Motor Tests - Subject test item motors to the evaluations of MTP 9-2-155.

j. Pressure Gage Tests - Subject test item pressure indicating gauges to appropriate quality assurance tests of MIL-G-8402.

#### 6.1.5 System Pre-Operational Tests

a. Heaters: Operate the test item for a minimum period of one hour. Record whether or not the following controls functioned:

- 1) Temperature control.
- 2) Overheat control.
- 3) Interlock control(s).

b. Auxiliary Power Units: Wiring should be checked for continuity and positive indication of no shorts between insulated wires and wiring conduits, junction boxes, raceways, etc.

NOTE: Major damage can occur to aircraft electrical system if an auxiliary power unit with reversed DC polarity is plugged into aircraft external power receptacle. Therefore, precautions should be taken against reverse polarity.

c. Air Compressors: Perform hydrostatic test on air compressors in accordance with applicable operation and service instructions draft technical manual. In addition, operate compressor(s) to determine proper operation of automatic start stop type controls, including over pressure release valves and/or emergency close-down devices.

#### 6.1.6 Ground Blower Heater Laboratory Tests

6.1.6.1 Fuel Analysis

Determine and record the heating value of liquid fuel in Btu's per gallon either from fuel characteristics charts or laboratory analysis.

NOTE: In some cases it may be necessary to have an ultimate analysis of fuel in terms of percent by weight of carbon and hydrogen.

6.1.6.2 Flue Gas Analysis

Draw a sample of the flue gas from near the center of the heater flue stack, approximately two inches above the thermocouple, and conduct a laboratory analysis of the oxygen, carbon monoxide, carbon dioxide content. Record the content of each.

6.1.6.3 Smoke Test

a. Draw a sample of smoke from the heater exhaust stack and conduct a laboratory analysis of its contents. Record the percentage of each ingredient present.

b. Photograph the smoke output for a period of five minutes with colored motion picture film.

6.1.7 Instrument Installation

6.1.7.1 Air Compressors

Install measuring devices or instruments required for operational performance testing which requires test item disassembly for installation.

6.1.7.2 Auxiliary Power Units (APU's)

Install measurement devices or instruments required for operational performance testing which requires test item disassembly for installation.

6.1.7.3 Ground Blower Heaters

Install the following:

a. A calorimeter to measure the heat developed by the burner unit.

NOTE: Instrument shall be placed approximately one inch into the main heat outlet, approximately three inches from the firebox.

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b. Calibrated thermocouples or mercury thermometers mounted in each duct at 2, 4, 6 and 8 feet from the blower motor/engine shaft (or the main heat outlet if no blower is applicable or if the blower is so located as to blow the air past the firebox/heating element), and at the fresh air intake to the burner.

c. Air pressure test round pipes and orifices.

6.1.8 Physical Characteristics

The physical characteristics of the test item(s) should be determined in accordance with applicable procedures of MTP 10-2-500, MTP 9-2-166, MTP 10-2-071, and MTP 9-2-286.

6.1.9 Operator Training and Familiarization

Test personnel shall receive training and familiarization in accordance with applicable procedures of MTP 10-2-501.

6.2. TEST CONDUCT

NOTE: Prepare an Equipment Performance Report for any equipment malfunction occurring during the conduct of the following procedures.

6.2.1 Ground Blower Heater Performance Tests

Determine the performance characteristics of the various ground support heaters in accordance with the general provisions of MIL-S-8512, the applicable testing procedure of MTP 10-2-071, and procedures of this document.

6.2.1.1 Heat Output Test (Standard Ambient Conditions)

a. Conduct this test at a location where the test item inlet air temperature is  $80 \pm 10$  degrees F. and large variations of temperature within the specified range are not expected.

b. In conjunction with test item instrumentation installation requirements of 6.1.7.3 provide measurement devices/instruments as follows:

- 1) Thermocouples.
- 2) Mercury thermometers.
- 3) Wet and dry-bulb thermometers.
- 4) Mercury barometer.
- 5) Anemometer, pitot tubes, or direct-reading velocity meter, as applicable.
- 6) Bureau of Standards type nozzle with coefficient of discharge of 0.936.

NOTE: Throughout the conduct of this test, the test item should burn only those fuels listed in the draft technical manual.

d. Record the type of fuel burned during the test, i.e., combat grade gasoline, diesel fuel type, JP-4, etc., as applicable.

e. With the Bureau of Standards type nozzle installed, measure the pressure drop across the nozzle,  $P_d$  for each selected discharge temperature. Record this data in conjunction with the data of step f for each selected discharge temperature and for each required static back pressure.

f. Measure and record the average test item inlet temperature,  $T_1$ , for each test condition specified by step e.

g. Measure and record the average test item outlet temperature for each selected discharge temperature and required static back pressure.

h. For the purpose of determining at a later time air density at the time of the heat output test, measure and record the following data during conduct of the heat output test:

- 1) Barometric pressure,  $BP_a$ .
- 2) Dry-bulb temperature,  $DB_a$ .
- 3) Wet-bulb temperature,  $WB_a$ .

i. During collection of the above required data, carefully observe the test item for evidence of abnormal operation, i.e., cylinder head temperature changes, erratic engine tachometer indications, etc.

#### 6.2.1.2 Ground Blower Heater Duct Tests

a. Seal the ends of a test item duct and connect a source of compressed air.

b. Increase the pressure within the duct to six psig. Record actual values.

c. Measure the leakage of air from the duct fabric and couplings. Record test item duct leakage.

d. Subject the test item duct to a tensile pull 150 pounds with the force applied to the end connections. Record evidence of duct breakage, cracks, tearing, loosening of connections, or other damage which would render the duct inoperative.

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e. Attach the duct to the pintle of a vehicle and drag the duct for 10,000 feet over rough concrete at a speed of 5 miles per hour or less.

NOTE: One end of the duct should be attached to the towing vehicle a maximum of three feet above ground in such a manner that the attached end does not rotate.

f. Record evidence of damage from the dragging abrasion of step e. Repeat step a, b, and c. Record increase in test item duct leakage.

#### 6.2.2 Portable Ground Support Air Compressor Tests

Determine the performance characteristics of the various ground support air compressors in accordance with the general provisions of MIL-S-8512, applicable testing procedures of MTP 9-2-166, MIL-C-26805, and the procedures of this document.

##### 6.2.2.1 Rated Capacity Test (Standard Ambient Conditions)

a. Conduct this test at a location where the air temperature is  $80 \pm 10$  degrees F. and large variations of temperature within the specified range are not expected.

b. In conjunction with test item instrumentation installation requirements of 6.1.7.1, provide measurement devices/instruments as follows:

- 1) ASME Power Test Code PTC-9 flow nozzle arrangement in accordance with sections 4-10 through 4-15 and 4-29 of that document.
- 2) ASME Power Test Code Supplements I&A long radius, low ratio flow nozzle described in Part 5, Chapter 4 of that document.
- 3) Thermocouples.
- 4) Mercury barometer.
- 5) Pressure gauges.
- 6) Differential pressure gauges.
- 7) Revolution counter.

c. Ensure that the test item is mounted on a level surface and verify that the procedures of 6.1.3 have been accomplished.

d. Start and operate the test item for eight hours at an ambient temperature of  $80 \pm 10$  degrees F. Record actual values.

e. During the last hour of operation, measure and record the following:



- 1) The average temperature,  $T_1$ , at the test item air inlet.
- 2) Test item air inlet pressure,  $P_a$ .
- 3) Test area barometric pressure,  $BP_a$ .
- 4) Differential pressure across nozzle,  $P$ .
- 5) Air temperature on compressor-side of nozzle,  $T_2$ .
- 6) Test item air receiver pressure.

f. Calculate and record test item volumetric rate of flow,  $Q_a$ , according to 6.4.

g. Record test item air discharge pressure and the compressor shaft revolutions per minute.

#### 6.2.2.2 Automatic Regulation

a. Repeat the conduct of 6.2.2.1, Rated Capacity Test, with the following changes to procedure:

- 1) Install a fifty percent capacity flow nozzle in the test item air discharge, according to ASME Power Test Code PTC-9.
- 2) Repeat 6.2.2.1 steps c and d with the test item air discharge completely shut off.

b. Calculate and record test item volumetric rate of flow,  $Q_a$ , according to 6.4.

NOTE: The value of  $Q_a$  obtained under 6.2.2.2 step b should not be less than fifty percent of the value obtained in 6.2.2.1, step e.

#### 6.2.3 Auxiliary Power Unit Performance Tests

Determine the performance characteristics of the various ground support auxiliary power units in accordance with the general provisions of MIL-S-8512, applicable testing procedures of MTP 9-2-286, MIL-STD-705, and procedures of this document.

##### 6.2.3.1 Voltage Dip or Rise for Rated Load (A-C Generator Sets)

a. Connect the test apparatus as shown in Figure 1 or Figure 2, as appropriate.

b. Operate the generator under voltage regulator control at rated speed and rated voltage.

c. Adjust the amplitude of the voltage trace so that the peak-to-peak distance is at least 3.5 inches. Adjust the oscillograph film

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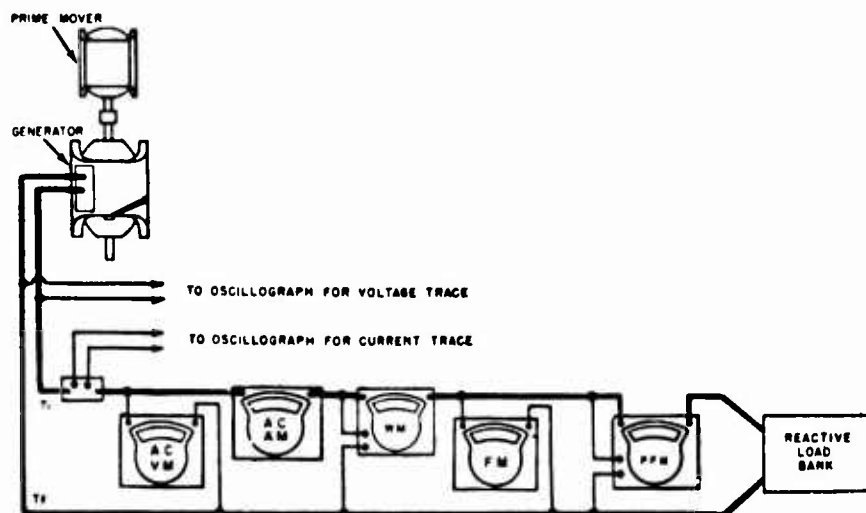


FIGURE 1: Voltage Dip or Rise for Rated Load, Test Set-Up (Single Phase).

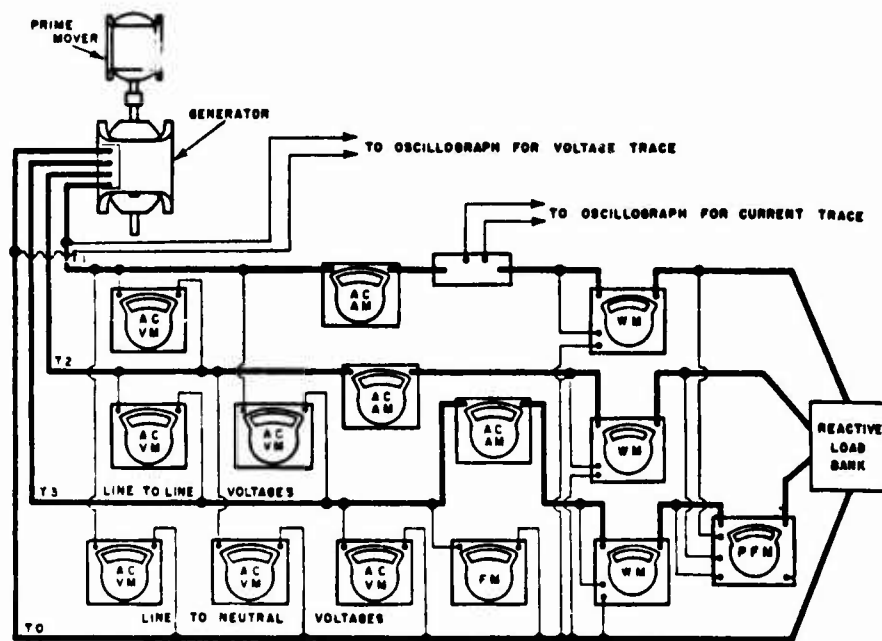


FIGURE 2: Voltage Dip or Rise for Rated Load, Test Set-Up (Three Phase).

speed so that individual peaks will be clearly visible. Record actual values.

d. Connect load of rated power factor to the generator terminals. Adjust this load to draw rated current when the generator is operated at rated voltage and rated speed. A balanced load is required for 3-phase machines. Record actual values.

e. Adjust amplitude of current trace on the oscillograph to at least 2 inches.

f. Disconnect the load from the generator.

g. Readjust the terminal voltage to rated values if necessary.

h. Record instrument readings.

i. Place the oscillograph in operation and reapply the load in one step.

j. Record the instrument readings and remove the load in one step.

k. Repeat c through j two times.

l. Determine that the ratios of the peak-to-peak voltage to the peak-to-peak current remain constant from the instant the load is first applied until steady-state conditions are reached.

#### 6.2.3.2 Regulator and Governor Stability and Transient Test

a. Connect the test apparatus in accordance with Figure 3.

b. Set the recording chart speed at twelve inches per minute for stability and transient response. For the long-term stability test, adjust the chart speed for twelve inches per hour.

c. Initiate test item operation and adjust the load bank and governor to obtain the rated values as specified in the draft technical manual. Readjust the governor and load as required to obtain the rated conditions of voltage, power factor, current, and frequency.

d. Operate the test item at rated speed, voltage, load, and power factor until temperatures have stabilized. Record the length of time required for stabilized operation.

e. Following temperature stabilization, drop and apply the load a sufficient number of times to ensure that the voltage regulator and governor return the terminal voltage and frequency to the rated outputs.

f. Before any load changes occur, read all meters and instruments and record the data. Initiate recording instruments; mark recording charts so that chart readings may be correlated with manual recorded

data at a later time.

g. Operate the test item at rated speed, voltage, load, and at rated power factor.

h. Reduce the load in one step to no load. Maintain the no-load condition until voltage and speed stabilization occur. Record the length of time required for stabilization at no-load.

i. Instantaneously apply approximately a full load; maintain the full-load condition until voltage and speed stabilization occur. Record the length of time required for stabilization at full load.

j. Repeat step h recording required data.

k. Repeat steps h and i for a seventy-five percent load a fifty percent load, and a twenty-five percent load.

l. To determine long term stability characteristics, determine stability as performed under steps a through j for a particular percentage load.

NOTE: Ensure that recording chart speed is twelve inches per hours.

m. Obtain a chart recording illustrating test item long term stability. See Figure 4 for a diagrammatic representation of a typical long-term stability chart and definitions of the data required for describing long term stability.

#### 6.2.4 Operation in Tilted Positions

##### 6.2.4.1 Ground Blower Heaters and Auxiliary Power Units

a. Tilt the complete test item in four different positions, ninety degrees apart, at an angle of nine to ten degrees from the horizontal.

b. Operate the test item at each of the positions specified by step a for a period of thirty minutes.

c. During operation of the test item in the tilted positions specified by step a, observe for and record evidence of abnormal or unsatisfactory characteristics. Repeat performance tests where doubt exists.

##### 6.2.4.2 Air Compressors

a. Tilt the air compressor under test in four different positions at an angle of fifteen degrees from the horizontal.

b. Allow the test item to stand for a period of four hours in each of the positions specified by step a.

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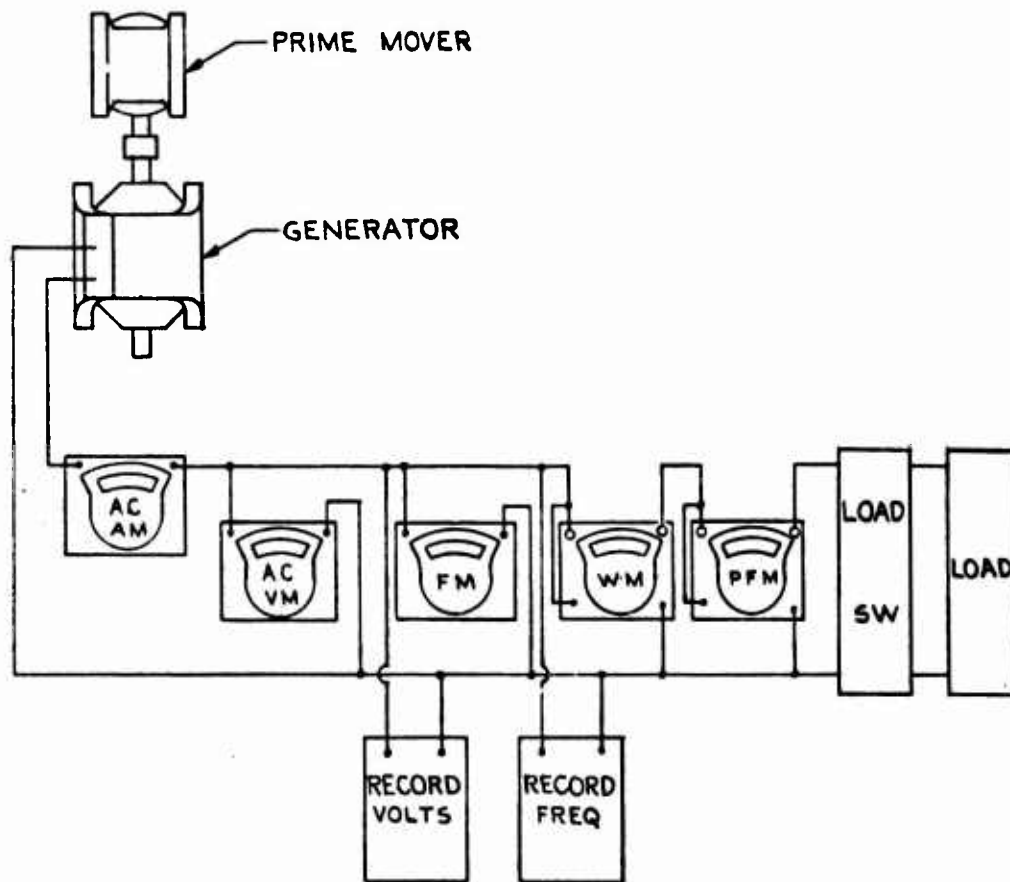
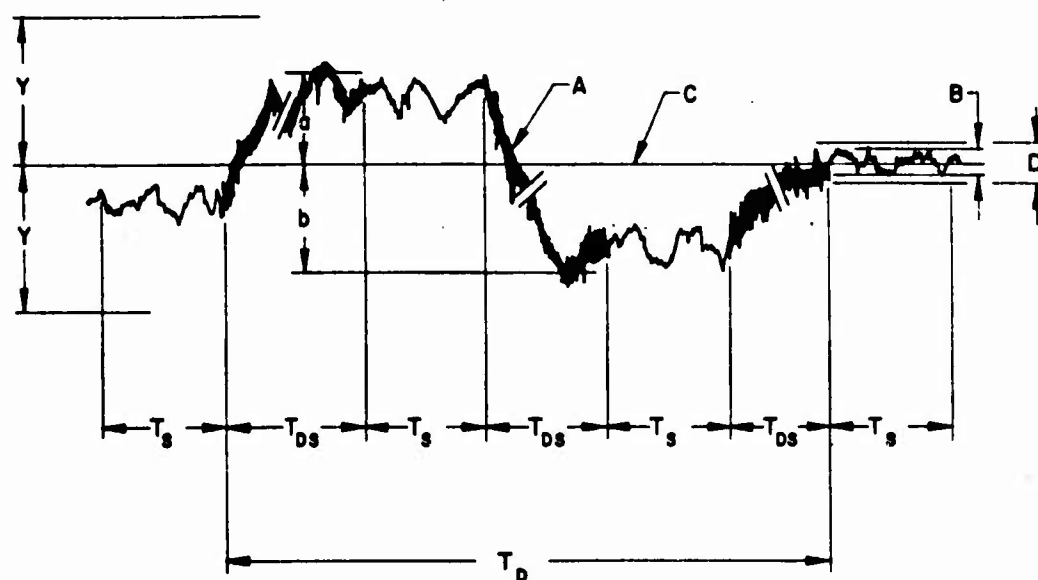


FIGURE 3: Regulator and Governor Stability & Transient Test Set-Up.



- A - ACTUAL INSTRUMENT TRACE OF FUNCTION
- B - OBSERVED STEADY STATE BAND
- C - MEAN OF OBSERVED BAND AND REFERENCE LINE
- D - PRESCRIBED STEADY STATE BAND
- $T_s$  - PRESCRIBED TEST SAMPLE TIME FOR STABILITY TEST
- $T_{Ds}$  - TIME BETWEEN STABILITY CHECK TESTS DURING DRIFT TEST
- $T_D$  - LONG TERM STABILITY OR DRIFT TIME
- a - MEAN EXCURSION OF TRACE ABOVE REFERENCE VALUE
- b - MEAN EXCURSION OF TRACE BELOW REFERENCE VALUE
- Y - PRESCRIBED LIMIT OF TRACE DURING DRIFT TEST

FIGURE 4: Diagrammatic Representation of Long Term Stability Test Recording (Including Definition of Applicable Terms).

c. Start and operate the test item in each of the step a positions for a period of thirty minutes. Observe the test item and monitor performance of compressor and drive engine. Record evidence of abnormal operation due to erratic fuel-feed or lack of proper lubrication while tilted.

6.2.5 Endurance Tests

6.2.5.1 Air Compressor Endurance Test

a. Subject the test item to one hundred and fifty hours of operation in accordance with MIL-C-26805. The operational period should be divided into alternate periods of loaded and unloaded operation, as follows:

- 1) Ten minutes loaded.
- 2) Fifty minutes unloaded.

b. Automatic or manual clutch couplings should be actuated a minimum of ten times per hour throughout the endurance test period.

c. Start and stop the test item a minimum of ten times per hour throughout the endurance test period.

NOTE: When sufficient air receiver capacity is available the stop-start cycle can be controlled by bleeding sufficient air from the receiver so that the test item compressor unit must stop and then start the required ten times per hour.

d. Conduct the performance tests of 6.2.2 at the completion of the endurance test period.

6.2.5.2 Ground Blower Heater Endurance Test

a. Subject the test item to one thousand hours of operation. The total test time should be divided as follows:

- 1) The first test period should consist of two hundred and fifty hours of operation under the following conditions:
  - a) Maximum air delivery.
  - b) Discharge temperature of 200 degrees F. (Standard ambient input conditions).
  - c) Static back pressures of 0, 3, 6, and 12 inches water gauge (fifty hours each).
- 2) The second test period should consist of two hundred and fifty hours of operation under the following conditions:
  - a) Minimum air delivery.
  - b) Discharge temperature 200 degrees F. (Standard ambient input conditions).

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- c) Static back pressures of 0, 3, 6, and 12 inches water gauge (fifty hours each).
- 3) The third test period should consist of two hundred and fifty hours of operation under the following conditions:
  - a) Maximum air delivery.
  - b) Discharge temperature of 150 degrees F. (Standard ambient input conditions).
  - c) Static back pressures of 0, 3, 6, and 12 inches water gauge (fifty hours each).
- 4) The fourth test period should consist of two hundred and fifty hours of operation under the following conditions:
  - a) Minimum air delivery.
  - b) Discharge temperature of 150 degrees F. (Standard ambient input conditions).
  - c) Static back pressures of 0, 3, 6, and 12 inches water gauge (fifty hours each).

b. Conduct the performance tests of 6.2.1 at the completion of the endurance test period.

#### 6.2.5.3 Auxiliary Power Unit Endurance Test

Subject the test item to one hundred hours of operation in accordance with MIL-STD-705, Method 690.1. These procedures are summarized as follows:

- a. The total test time should be divided as follows:
  - 1) The first test period should consist of twenty hours with the test item operating with a seventy-five percent load.
  - 2) The second test period should consist of twenty hours with the test item operating with a one-hundred percent load.
  - 3) The third test period should consist of twenty hours with the test item operating with a fifty percent load.
  - 4) The fourth test period should consist of twenty hours with the test item operating with a seventy-five percent load.
  - 5) The fifth and final test period should consist of twenty hours with the test item operating with a twenty-five percent load.

- NOTES:
- 1. One-hundred percent rated load means full-rated load on both the battery-charging generator, if applicable, and the main generator.
  - 2. If for any reason the instrumentation or the load has to be interrupted during the endurance test, the test item should not be shut down, but continued in operation under no-load until appropriate repairs are made.



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b. Throughout the endurance test, the test item should be under constant observation and inspection. Record any malfunction or damage to the unit.

c. Use recording voltmeter(s) and recording frequency meter(s) for continuous recording during conduct of the test.

d. Conduct the performance tests of 6.2.3 at the completion of the endurance test period.

6.2.6 Self-Propelled Ground Support Equipment Mobility Tests

Determine the mobility characteristics of each self-propelled test item type according to applicable procedures of MTP 2-2-612.

6.2.7 Towed or Manually Propelled Ground Support Equipment Mobility Tests

Determine the mobility characteristics of each towed or manually propelled test item type according to MIL-M-8090. Applicable tests of that document are summarized in the paragraphs which follow.

NOTE: Where possible, wheeled aircraft towing tractors which have been evaluated according to MTP 7-2-105 should be employed for the towing tasks specified by this procedure.

6.2.7.1 Parking Brake Test

a. With the test item situated on a level, brushed concrete surface, apply the test item parking brake.

b. Apply through a series connected dynamometer a towing force parallel to the towing surface which is sufficient to move the test item. Record the following:

- 1) Evidence that the wheels containing the parking brakes rolled or skidded.
- 2) Actual parallel force applied.

c. With the test item containing a full complement of fuel and/or other authorized supplies or components, situate the test item on a dry incline of sixty percent. Apply the parking brake.

d. Record whether or not the test item parking brake held the test item motionless on the incline specified.

6.2.7.2 Service Brake Test

a. Couple the complete test item to an appropriate towing vehicle. Record the prime mover type employed.

b. Instrument the towing vehicle/test item combination such that the following data is automatically recorded:

- 1) Vehicle combination speed in respect to time.
- 2) Time at which towing vehicle brake pedal is depressed.
- 3) Deceleration recording trace synchronized to brake pedal actuation.
- 4) Test item lateral acceleration ("jackknife" moment).

c. Tow the test item at a range of speeds varying from the

minimum expected tow speed to that maximum towing speed safe for the following two surfaces.

- 1) Clean, dry, smooth concrete.
- 2) Clean, dry, smooth macadam.

d. As the test item is being towed at each speed increment for each type of towing surface, cause the towing vehicle operator to initiate sudden, simulated emergency stops. Make appropriate notations on automatic recording charts to indicate surface type and other data necessary to identify these records for analysis.

#### 6.2.7.3 Improved Level Surfaces Mobility Test

Simulate test item operation over broken, level concrete or asphalt surfaces and determine mobility characteristics of the test item.

a. Construct a test course consisting of one inch in height obstructions fixed to a level, concrete or asphalt surface. The obstructions should be placed at intervals of six feet and at right angles to the intended direction of travel.

b. Couple the complete test item to a towing vehicle possessing an appropriate pintle of the proper height.

c. Tow the test item at an average speed of five miles per hour (not to exceed seven and one-half miles per hour, maximum) for a distance of not less than five miles over the obstruction course of step a. During the performance of this test, complete a minimum of fifty right circle turns and fifty left circle turns at the maximum cramping angle.

d. Employing a dynamometer connected between the towing vehicle and the test item, measure the force required to tow the test item over level concrete or asphalt surfaces without obstructions. Record actual values.

e. Repeat step d with the exception that the test item is towed over the obstructions specified by step a. Record the average force required to tow the test item.

f. At the conclusion of the tests, examine test item running gear and record evidence of excessive wear or other damage.

g. Repeat the performance tests intended to determine test item technical capabilities for the specified mission. Record these results.

#### 6.2.7.4 Partially Improved Terrain Mobility Test

a. Couple the complete test item to a towing vehicle possessing an appropriate pintle of the proper height. Record the type towing vehicle used.

b. Tow the test item over level paved highways at an average speed of twenty miles per hour for a distance of fifty miles.

c. Following the completion of step b, tow the test item over graded, gravel roads at an average speed of ten miles per hour for a distance of fifty miles.

d. At the completion of step c, repeat 6.2.4.3 step c, step d, and step e. Record data required by those procedures.

e. At the conclusion of the tests, examine test item running gear and record evidence of excessive wear or other damage.

f. Repeat the performance test intended to determine test item technical capabilities for the specified mission. Record these results.

6.2.8 Broadband Radio Interference Tests

Subject the test item to appropriate procedures of MTP 2-2-613 and applicable requirements of MIL-STD-461, MIL-STD-462, and MIL-STD-463.

6.2.9 Vibration and Shock Tests

6.2.9.1 Ground Blower Heaters and Portable Air Compressors

Subject ground blower heaters and portable air compressors to the procedures of FED-STD-101, Methods 5007 and 5019, and MIL-E-4970 Procedure IV-Category A Equipment. Record resulting test data.

6.2.9.2 Auxiliary Power Units

Subject auxiliary power units to the procedures of MIL-STD-705. Record resulting test data.

6.2.10 Climatic Extremes Tests

Performance testing of each test item type, i.e., portable air compressor, ground blower heater, etc., under desert, arctic, and tropic conditions should be performed in accordance with MTP 2-4-001, 2-4-002, and MTP 2-4-003.

6.2.11 Intermediate Climatic Tests

Subject the test item(s) to climatic conditions representative of the Intermediate Climate as defined by AR 70-38. Use the following procedures and applicable tests contained in MIL-STD-810B.

6.2.11.1 Rain Test

Determine ability of the ground support service equipment under test to perform as intended when subjected to rain. Proceed as follows:

a. Park the test item on a horizontal surface and expose to natural or simulated rain falling toward the test item at an angle of approximately 45 degrees to the horizontal. The volume of rain impinging

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on the horizontal surface shall be not less than 1/4 gallon per minute per square foot of wetted, horizontal area. Simulated rain shall originate from a source which produces droplets of uniform distribution and velocity similar to natural rain at the point of contact with the item. Conduct the test as follows:

- 1) Expose the top and left side to the rain as described above for a period of 5 minutes with the engine shut down.
- 2) With water flowing, start engine within 2 minutes (without removing accumulated water) and allow engine to idle for 2 minutes.
- 3) Repeat (1) and (2) with the top and front exposed.
- 4) Repeat (1) and (2) with the top and right side exposed.

b. At the conclusion of the test, examine the test item for the following:

- 1) Water in the air-intake filter.
- 2) Water leakage into the torque-converter oil chambers, engine crankcase sump, transmission, fuel tank, and hydraulic reservoir (when provided).
- 3) Performance of the electrical components, gauges, and instruments.

NOTE: Water in the air-intake filter in excess of 8 percent of the fluid capacity of the sediment chamber will constitute a malfunction.

c. Record:

- 1) Rain test conditions and test parameter.
- 2) Results of subtests.
- 3) Findings of inspection following tests.

#### 6.2.11.2 Low Temperature Tests

##### 6.2.11.2.1 All Test Item Types Test -

a. Service the test item with lubricants and other fluids in accordance with the draft technical manual for temperatures not to exceed the lower limit of the intermediate climate AR 70-38

b. Park the test item on a horizontal surface and expose to natural or simulated low temperatures. Record the stabilized values.

c. Start prime mover engines by cranking with the batteries which are on the test item and have been stabilized at the low temperature.

Consult MTP 2-2-650. Record the results of this test including the length of time required for engine starting.

NOTE: Do not use substitute batteries or other external cranking energy.

d. At the completion of low temperature testing, examine and inspect each test item type for the effects of low temperatures, including the following:

- 1) Differential contraction of metal parts.
- 2) Loss of resiliency of packings and gaskets.
- 3) Congealing of lubricants.

e. Record the effects of low temperatures on each test item type.

#### 6.2.11.2.2 Air Compressors Low Temperature Test

a. Perform the low temperature test, Method 502, Procedure I, of MIL-STD-810B with a 100% capacity flow nozzle installed in the compressor air discharge, and with the following additional requirements.

- 1) Subject the test item to a temperature of minus 25° F. for a period of not less than 24 hours.
- 2) Start up the test item twice, but do not run it.
- 3) Start the test item a third time, and allow it to run only long enough to establish steady operation. Then adjust the test item controls for compressor cyclic operation, and allow it to operate until the engine and compressor coolant and lubricating oils have stabilized.

b. Record all test results.

#### 6.2.11.2.3 Ground Blower Heater Low Temperature Test -

Repeat 6.2.1.1 Heat Output Test, with the following changes in procedure:

a. Control the heater inlet air temperature beginning at minimum twenty-five degrees F. in ten degree increments and measure the quantities required by 6.2.1.1.

b. Alter static back pressures, and continue the test until measurements have been made at a temperature of thirty-two degrees F.

#### 6.2.11.2.4 Auxiliary Power Unit Low Temperature Test -

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Conduct low temperature testing in accordance with MIL-STD-705, Methods: 701.1b, 701.2b, 701.4a, and 702.1a.

6.2.11.3 High Temperature Tests

6.2.11.3.1 All Test Item Types Test -

a. Service the test item with lubricants and other fluids in accordance with the draft technical manual for temperatures not to exceed the upper limit of the intermediate climate (AR 70-38.)

b. Park the test item on a horizontal surface and expose to natural or simulated high temperatures. Record stabilized values.

c. Start prime mover engines; record the length of time required.

d. At the completion of high temperature testing, examine and inspect each test item type for the effects of high temperatures, including the following:

- 1) Permanent set of packings and gaskets.
- 2) Binding of parts in equipment of complex construction due to differential expansion of dissimilar metals.
- 3) Rubber, plastic, and/or plywood parts which discolored, cracked, bulged, or crazed.
- 4) Closure and sealing strips which became gummy or stuck to contracting parts.

6.2.11.3.2 Air Compressor High Temperature Test -

a. Perform the high temperature test, Method 501, Procedure I, of MIL-STD-810B with a 100% capacity flow nozzle installed in the compressor air discharge.

b. Run the test item for not less than 8 hours with only the housing covers that are hinged in an open position. No adjusting or replacement of the engine, or the compressor components, should be permitted after the first hour of operation.

c. Record the following data at 30-minute intervals during the remaining 7 hours of test:

- 1) Engine coolant liquid temperature.
- 2) Engine lubricating oil temperature.
- 3) Compressor lubricating oil temperature.
- 4) The data described under item d of 6.2.2.1, Rated Capacity Test.

d. Calculate and record the compressor volumetric rate of

flow,  $Q_a$ , as determined in step e of 6.2.2.1, Rated Capacity Test.

6.2.11.3.3 Ground Blower Heater High Temperature Test -

Repeat 6.2.1.1 Heat Output Test, with the following changes in procedure.

a. Control the heater inlet air temperature beginning at thirty-two degrees F. in ten degree increments and measure quantities required by 6.2.1.1.

b. Alter static back pressures, and continue the test until measurements have been made at a temperature of one-hundred and twenty-five degrees F.

6.2.11.3.4 Auxiliary Power Unit High Temperature Test -

Conduct high temperature testing in accordance with MIL-STD-705, Method 710.1b.

6.2.11.4 Salt Fog

Perform the salt fog test, Method 509, of MIL-STD-810B, and record all test results. At the completion of the salt fog test, examine and inspect each test item type for the effects of a salt atmosphere, including the following:

- a. Corrosion of metals.
- b. Test item moving parts which become clogged from salt deposits.

6.2.11.5 Sand and Dust Test

Perform the sand and dust test, Method 410 of MIL-STD-810B, and record all test results. At the completion of the sand and dust test, examine and inspect each test item type for the effects of sand and dust, including the following:

- a. Abrasion of test item moving parts.
- b. Test item finish (paint) damaged.
- c. Test item parts which were caused to bind by sand or dust.
- d. Evidence of interference with test item electrical contacts.

6.2.11.6 Altitude

Perform the altitude test, Method 500 of MIL-STD-810B, Procedure I, in conformity with the requirements specified in par. 6.2.3.2, with the pressure in the altitude chamber held at 20.6 inches of mercury (corresponding to an altitude of 10,000 feet), and record all test results.

6.2.12 Transportability

Evaluate the transportability characteristics of the item.

NOTE: Personnel should be familiar with the applicable portions of the following documents:

- 1) MIL-STD-129 Marking for Shipment and Storage.
- 2) MIL-STD-209 Slings Eyes and Attachments for Lifting and Tying Down Military Equipment.
- 3) MIL-STD-1186 Cushioning, Anchoring, Bracing, Blocking, and Waterproofing: Appropriate Test Methods.

a. The draft technical manual shall be reviewed or consulted for proper procedures for tying down, lifting, and transporting the test items by various media. Any inadequacy of instructions should be reported by EPR.

b. Evaluate the transportability characteristics of the test items accomplishing the applicable procedures of MTP 10-2-503. Note the test data.

c. Evaluate the effectiveness of tiedown/securing devices and lifting attachments using MIL-STD-209 as a basis for the evaluation.

6.2.12.1 Preparation for Test

6.2.12.1.1 Lifting and Towing-Eye Test -

a. Pick up the test item using the provided lifting eyes. Use a spring balance connected such that the test item weight can be determined. Record the weight value.

b. Measure and record the angle formed between the test item and the horizontal while suspended and clearing the ground.

c. Set the test item on a secure base.



d. Bolt the test item to the base such that an applied force of eight times the test item measured weight will not cause the test item to move.

e. Repeat step a applying a vertical force equal to eight times the test item weight measured in step a.

f. Release the vertical force and remove lifting hooks from the test item lifting eyes. Examine the test item and record evidence of any deformation or damage.

g. With the test item still bolted as specified by step d, attach a winch and scale to the test item towing eye and apply a horizontal force equal to five times the test item weight. Examine the test item and record evidence of towing eye deformation or damage to the test item.

6.2.12.1.2 Preservation and Packing -

Prepare the test item for transport in accordance with:

a. Ground Support Air Compressors: Provisions of MIL-C-26805 and FED-STD-101.

b. Ground Support Blower Heaters: Provisions of draft technical manual.

c. Ground Support Auxiliary Power Units: Provisions of draft technical manual.

6.2.12.2 Rail Transport Test

a. Load the test item onto a railway flatcar and secure with lashings, bracing, blocking, and cushioning material in accordance with provisions of MIL-STD-1186.

b. Attach recording accelerometer sensors to the railcar along the longitudinal, transverse, and vertical axes. Record the following:

- 1) Equipment used for loading
- 2) Difficulties encountered during loading operations.
- 3) Materials description used for securing, etc.
- 4) Location of accelerometer sensors.

c. Operate the railroad car over a fifty mile (minimum length) course at normal operating speeds. Perform five abrupt starts and five abrupt stops from varying speeds. Record the following:

- 1) Speed prior to abrupt stop.
- 2) Accelerometer shock-vibration recording charts.
- 3) Damage incurred by the test item, including packing material.

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d. The test item shall be subjected to the abrupt shock of railway "in-motion" couplings (humped couplings). The test item shall be loaded and secured to a flatcar (see a above) of 169,000 pounds (minimum). With the test item flatcar brakes set to "ON", couplings shall be accomplished at various speeds, including 4, 6, and 8 mph. Record the following:

- 1) Speed at which the "humped couplings" were made.
- 2) Flatcar weight, etc.
- 3) Accelerometer sensor recordings.
- 4) Buffer-device movements.
- 5) Damage to test item or packaging material.

NOTE: Auxiliary Power Units should be subjected to Method 740.5a Railroad Humping Test of MIL-STD-705. Consult draft technical manual and/or governing documentation.

e. During conduct of the rail transport test, the test item shall be checked for evidence of overhang against Association of American Railroads (AAR), Berne International, and Composite (Broad Gage) clearance devices. Record the following:

- 1) Overhang/restrictions encountered. Include all available information.
- 2) Test item disassembly required for clearance.
- 3) Time to disassemble, etc., if applicable.

f. Unload the test item from the railcar and record the following:

- 1) Materials handling equipment (MHE) used during unloading.
- 2) Difficulties encountered during unloading.

g. Disassemble the test item and inspect components for damage. Record the findings of this inspection.

#### 6.2.12.3 Vehicle Transport Test

a. Load the test item aboard appropriate highway-type transport vehicle. Use MHE as required. Record the following:

- 1) Type of transport vehicle.
- 2) MHE used during loading.
- 3) Method and materials used for securing test item.
- 4) Difficulties encountered during loading operation.

b. Attach accelerometer sensors to the carrier to obtain shock readings which occur during transport along the longitudinal,

transverse, and vertical axes. Record the locations of these sensors.

c. Drive the loaded carrier at various safe speeds not to exceed 45 miles per hour. The road types listed below shall be transversed for a minimum distance of five miles each.

- 1) Improved gravel road.
- 2) Cobblestone road.
- 3) Loose-rock road.
- 4) Paved highway.
- 5) Washboard road. (Two-inch washboard, minimum).

d. Emergency stopping: With the test item loaded on the carrier, and with the hand brakes set to the "ON" position, determine the adequacy of test item securing methods and test item ability to withstand shock forces which could occur during normal vehicular transport. Proceed as follows:

- 1) Instrument the transporter bed with recording accelerometer sensors along the transverse, longitudinal, and vertical axes.
- 2) Conduct emergency stopping tests a minimum of three times on a dry, level, straight, and paved surface which is free of foreign objects from a speed of ten mph. Determine and record following each emergency stop:
  - a) Adequacy of securing devices and methods.
  - b) Adjustments required to securing devices.
  - c) Braking distance(s).
  - d) Recording accelerometer reading/charts.
  - e) Damages sustained by test item or vehicular carrier.
- 3) Photograph the emergency stopping portion of the test with still and motion picture cameras. In particular, photograph stopping performance, shifting of test item, and incurred damage(s).
- 4) Repeat step a through c for speeds of 20, 30, and 45 mph.

e. Following conduct of the vehicular transport test, the test item should be disassembled and inspected for component damage. Record the findings of this inspection.

#### 6.2.12.4 Marine Transport Test

a. Load the test item aboard a transport-type ship of the appropriate class, or a ship simulation facility capable of duplicating shipboard loading conditions and ship motion (pitch and roll). Use normal MHE. Record the following:

- 1) Ship type (actual or simulated).

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- 2) MHE utilized during loading.
- 3) Materials and methods used for securing test item.
- 4) Difficulties encountered during loading.
- 5) Conduct a rough water trip, if possible, with wave heights of 5 feet and 10 to 18 feet high at wind speeds of 28 to 31 knots. Record the following:
  - a) Sea state.
  - b) Wind speed and direction.
  - c) Recording accelerometer readings/charts.
  - d) Damage to test item or bracing.

b. Where actual transport vessels are not available, subject the packaged test items to ship motion simulation of  $\pm 30^\circ$  roll, 30-second period and pitch angles of  $\pm 5^\circ$  with a 20-second period. Conduct the test for one hour, minimum. Record the following:

- 1) Actual pitch/roll values.
- 2) Accelerometer recordings readings.
- 3) Damage to test item or packaging material.

#### 6.2.12.5 Air Transport Suitability Tests

The test item should be prepared for transport by TOE personnel and subjected to the evaluation of MTP's 7-2-509 and 7-2-510.

#### 6.2.13 Maintenance and Reliability Evaluation

Evaluate the maintenance-related factors of the test item as described in MTP 10-2-507 with emphasis on the following:

##### a. General.

- 1) Organizational (O), Direct Support (F), and General Support (H) Maintenance requirements.
- 2) Operator through General Support Maintenance Literature.
- 3) Repair parts.
- 4) Tools.
- 5) Test and handling equipment.
- 6) Calibration and maintenance facilities.
- 7) Personnel skill requirements.
- 8) Maintainability.
- 9) Reliability.
- 10) Availability.

##### b. Specific (all test item types).

Consult TM 55-405-8, Army Aviation Maintenance Engineering Manual Ground Support Equipment, Chapter 4, "General Maintenance".

c. Specific (by test item type).

- 1) Ground Blower Heaters: The maintenance evaluation should stress accessibility to certain components for maintenance and/or removal from the test item. In particular, the following components or areas should be considered:
  - a) Heater igniter.
  - b) Fuel nozzle.
  - c) Heater magneto or vibrator.
  - d) Fuel pump.
  - e) Power package.
  - f) Heat generator.
  - g) Ventilating air blower.
  - h) Combustion air blower.
- 2) Air Compressors: The maintenance evaluation should stress accessibility to certain components for maintenance and/or removal from the test item. In particular, the following components or areas should be considered.
  - a) Air hose removal.
  - b) Automatic operation valves and switches.
  - c) Belts or drive chains.
- 3) Auxiliary Power Units: The maintenance evaluation should stress accessibility to certain components for maintenance and/or removal from the test item. In particular, the following components or areas should be considered:
  - a) Motor/generator brushes, if applicable.
  - b) Wiring and terminal boards.
  - c) Speed control, automatic or manual.
  - d) Prime mover engine/motor.

6.2.14 Safety

Provide a safety release statement in accordance with USATECOM Regulation 385-6. Observe all normal precautions governing the operation of ground support service equipments and test equipment. Applicable vehicular safety characteristics should be evaluated during conduct of the mobility tests in accordance with MTP 2-2-508. In addition, conduct the following evaluations.

6.2.14.1 Ground Blower Heater Safety Evaluation

a. Set up the test item for normal operation at a location suitable for explosion testing. All other precautions should be observed and arrangements made for observation of the test item from protected positions.

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b. With the test item heat exchanger operating at a temperature of 60-100 degrees F., charge the unit (from a remote position) with a fuel mixture of at least ten times the volume of the combustion chamber.

c. Ignite the mixture from a remote, protected position. An explosion should result.

d. When it has been determined that it is safe to examine the test item, determine the following:

- 1) Subject the heat exchanger to leakage tests; the exchanger should not be distorted.
- 2) The combustion chamber state, i.e., distorted, etc.
- 3) Evidence of components, etc., blown loose which could have resulted in personal injury and/or damage to parked aircraft in normal use.

e. When it has been determined that the test item was not physically damaged by the explosion test, conduct 6.2.1 and record whether performance was altered.

6.2.14.2      Ground Support Service Equipment Safety Evaluation, General

a. Determine that door interlocks, over-pressure devices, automatic controls, hoses, and unfired pressure vessel malfunctions are not likely to cause human injury or aircraft damage.

b. During conduct of all engineering tests, observe the safety characteristics of the test item and record the following:

- 1) Any dangerous or unsafe condition or any condition that might present a safety hazard including the cause of the hazard. Record the steps taken to alleviate any such hazard.
- 2) The safety features incorporated into test item design.
- 3) Adequacy of warning instructions and markings.
- 4) Suggestions to improve the existing safety precautions.

c. Throughout the engineering tests observe standard safety precautions.

6.2.15      Human Factors Evaluation

6.2.15.1      General Evaluation

Determine the degree to which the design and performance of the test item satisfy accepted standards for human factors. The applicable portions of the HEDGE (Human Factors Evaluation Data for General Equipment) will be used for the test. In particular, checklists will be prepared for all tasks associated with the HEDGE Class III C test functions which rate the task from a human factors standpoint as either satisfactory or not

satisfactory. Include the following:

a. For all tasks the following factors will be considered:

- 1) Adequacy of instructions and tools to perform the task.
- 2) Mental and physical effort required.
- 3) Design of the test item as it affects the task.
- 4) Time required for the task.
- 5) Personnel required for the task.

b. Perform the following tasks for the HEDGE test functions given. The factors considered shall include but not be limited to those of Section a above.

- 1) Operability.
  - a) Assemble and set up.
  - b) Prepare for use.
  - c) Activate/deactivate and perform prime function.
- 2) Maintainability.
  - a) Perform routine maintenance.
  - b) Detect malfunction and isolate and identify cause.
  - c) Remove defective component and replace or repair.
- 3) Transportability.
  - a) Prepare for transport.
  - b) Load/unload.
  - c) Record any inadequacies of test item design affecting ease of operation.
  - d) Record any recommendations to improve man-item effectiveness.

c. Determine the highest sound pressure level in each band over all of the bands at each measuring location (Table 2).

TABLE 2

SERIES 2 FREQUENCY ANALYSIS

BAND	FROM	TO	CENTER FREQUENCY*	MAX. STEADY STATE NOISE LEVEL
1	45	90	63	119
2	90	180	125	114
3	180	355	250	107
4	355	710	500	99
5	710	1400	1000	91
6	1400	2800	2000	89
7	2800	5600	4000	89
8	5600	11,200	8000	91

\*Defined as geometric mean of cut-off frequencies.

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d. For the point of highest sound pressure in each band, determine also the ambient noise level (test item inoperative).

6.2.15.2            Noise Evaluation

Obtain a sound level meter and an octave band filter set. The test shall be conducted with the test item in its normal operating mode. Where size permits and the facility is available, the test will be conducted in a sound anechoic chamber. There should be no obstructions between the sound sensor and the test item. Measuring locations for the sensor shall be at the working positions of the operator. The sensor should be oriented upwards with the longitudinal axis of the microphone perpendicular to the noise source. Perform the following:

a. Calibrate the sound level meter and set the weighting network switch to the "flat response", or C position.

b. Have the test item operating as it is normally used.

6.2.16            Value Analysis

Throughout all tests, the test item shall be examined for any unnecessary, costly, "nice-to-have" features as described in USATECOM Regulation 700-1. Perform the following:

a. During operation of the test item, observe for features which could be eliminated without compromising performance, reliability, durability, or safety.

b. Question test personnel regarding features of the test item which could be eliminated without decreasing the functional value of the test item or decreasing man-item effectiveness.

c. Record the following:

- 1) Nonfunctional, costly, or "nice-to-have" features of the test item.
- 2) Test personnel comments and opinions regarding features to be eliminated.

6.2.17            Quality Assurance

Throughout all tests, examine the test items for compliance with the quality requirements of the applicable MN and the provisions of MTP 10-2-511.

6.3                TEST DATA

6.3.1            Initial Inspection



Record the following:

- a. Data required by applicable procedures of MPT 10-2-500.
- b. Evidence of damage or deterioration of test item or materials used for protection during shipment.
- c. Identification markings which were not in accordance with MIL-STD-129, MIL-STD-130, or test item detail specification.
- d. Evidence of defects in:
  - 1) Manufacturing.
  - 2) Material.
  - 3) Workmanship.
- e. Engine not prepared for storage in accordance with MIL-E-10061.

6.3.2 Inventory Check

Record the following:

- a. Missing maintenance literature or draft technical manual(s).
- b. Shortages in repair parts, accessories, or tools.
- c. Missing kits.

6.3.3 Inspection and Preliminary Operation

Record the following:

- a. Data required by procedures of MTP 2-2-502.
- b. Data required by applicable procedures of MTP 2-2-505.

6.3.4 Ground Blower Heater Fuel Test

Record the heating value of test item fuel(s), in Btu per gallon.

6.3.5 Ground Blower Heater Flue Gas Analysis

Record chemical content of each sample:

- a. Oxygen.
- b. Carbon monoxide.
- c. Carbon dioxide.

6.3.6 Physical Characteristics

Record the percentage of each ingredient present in each sample.

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6.3.7      Physical Characteristics

Record the following:

- a. Data required by applicable procedures of MTP 10-2-500.
- b. Data required by applicable procedures of MTP 10-2-071 and MTP 9-2-286 (Physical Characteristics sections).

6.3.8      Operator Training and Familiarization

Record the following:

- a. Data required by MTP 10-2-501
- b. For personnel requiring retraining:
  - 1) Name.
  - 2) Rank.
  - 3) Past experience.
  - 4) Degree of retraining required.
- c. Test director evaluation of test personnel as a team.
- d. For each team member:
  - 1) Rank.
  - 2) Unit.
  - 3) Experience.
  - 4) Previous training.
  - 5) Adequacy of technical manual(s) for training purposes.

6.3.9      Ground Blower Heater Heat Output Test

Record the following:

- a. Type of fuel burned during the test, i.e., JP-4, etc.
- b. Pressure drop across the nozzle,  $P_d$ , inches of water.
- c. Average air inlet temperature,  $T_1$ , in degrees F. (for each selected output temperature and static backpressure condition.
- d. Average outlet temperature, in degrees F.
- e. Barometric pressure,  $BP_a$ , in inches of mercury.
- f. Dry-bulb temperature (ambient), in degrees F. ( $DB_a$ ).
- g. Wet-bulb temperature,  $WB_a$ , in degrees F.

h. Subjective observation of test item operation.

i. Evidence of abnormal operation, i.e., cylinder head temperature changes, erratic engine tachometer indications, etc.

6.3.10 Ground Blower Heater Duct Test

Record the following:

a. Duct test pressure, in psig.

b. Leakage, cubic feet per hour.

c. Tensile force applied to test item.

d. Evidence of test item duct damage due to force application, i.e., tearing, loosening of connections, etc.

e. Distance over which test item duct was dragged, in feet.

f. Speed at which test item duct was towed, in miles per hour.

g. Record evidence of damage to test item following drag test.

h. Data required by steps a, b, and c.

i. Increase in test item leakage, due to drag damage.

6.3.11 Air Compressor Rated Capacity Test

Record the following:

a. Ambient temperature, in degrees F.

b. Average test item air inlet temperature, in degrees F.

c. Test item inlet pressure,  $P_a$ , in inches of water.

d. Test area barometric pressure,  $BP_a$ , in inches of mercury.

e. Air temperature on compressor-side of nozzle,  $T_2$ , in degrees F.

f. Test item receiver pressure, in psig.

g. Test item volumetric rate of flow,  $Q_a$ , cubic feet per minute.

- h. Discharge pressure, in psig.
- i. Compressor shaft revolutions, in rpm.

6.3.12      Air Compressor Automatic Regulation

Record the data required by 6.3.9 with the fifty percent flow nozzle installed in the test item.

6.3.13      Auxiliary Power Unit Voltage Dip or Rise Test

Record the following:

- a. Peak-to-peak voltage trace amplitude, in inches.
- b. Voltage and current values when test item is operated with rated power factor load.
- c. Record all instrument readings with load disconnected.
- d. Instrument readings with load reconnected.
- e. Instrument readings with load disconnected.

6.3.14      Auxiliary Power Unit Regulator and Governor Stability Test

Record the following:

- a. Chart speed, inches per minute or hours, as applicable.
- b. Length of time required to obtain stabilized operation at rated temperature.
- c. With test item operating with rated load, chart recordings of voltage, current, and frequency, make proper notations on charts for correlation purposes at later time.
- d. Time required for test item voltage and frequency to stabilize following removal of load.
- e. Retain recordings of load stability runs for seventy-five, fifty, and twenty-five percent loads.
- f. Retain a chart recording of test item long term stability characteristics (chart speed of twelve inches per hour).

6.3.15      Operation in Tilted Positions

6.3.15.1      Ground Blower Heaters and Auxiliary Power Units

Record the following:

conducted.

- a. Angles and positions at which operation of test item was
- b. Length of time test item operated, at each position and
- c. Evidence of abnormal test item operation.

angle.

6.3.15.2 Air Compressors

Record the following:

- a. Angles and positions at which test item was operated.
- b. Time test item was held at each position and angle.
- c. Time test item was operated in each position, in minutes.
- d. Evidence of abnormal test item operation due to erratic fuel feed or lack of proper lubrication due to tilt or position.

6.3.16 Air Compressor Endurance Test

Record the following:

- a. Number of hours test item was operated.
- b. Schedule of load and non-load operation for each hour of test operation.
- c. Number of times automatic or manual clutch was operated each hour of test operation.
- d. Number of times test item was stopped and restarted each hour of test.
- e. Data of 6.2.2 tests conducted following endurance test.

6.3.17 Ground Blower Heater Endurance Test

Record the following:

- a. Total time in hours test item was operated during test.
- b. Schedule of operation for:
  - 1) Maximum air delivery, discharge temperature of 200 degrees F. and static back pressures of 0, 3, 6, and 12 inches of water.
  - 2) Minimum air delivery, discharge temperature of 200 degrees F., and static back pressures of 0, 3, 6,

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and 12 inches of water.

- 3) Maximum air delivery, discharge temperature of 150 degrees F., and static back pressures of 0, 3, 6, and 12 inches per hour.

c. Data required by 6.2.1 tests following endurance test.

6.3.18

Auxiliary Power Unit Endurance Tests

Record the following:

- a. Data of MIL-STD-705, Method 690.1.
- b. Length of time test item was operated with a seventy-five percent load.
- c. Length of time test item was operated with a fifty percent load.
- d. Length of time test item operated with a one hundred percent load.
- e. Length of time test item operated with a twenty-five percent load.
- f. Malfunctions occurring or damage to test item during test.
- g. Retain recording charts of voltage and frequency made during conduct of each subtest.
- h. Data required by 6.2.3 tests conducted at completion of endurance test.

6.3.19

Self-Propelled Ground Support Equipment Mobility Tests

Record the data required by applicable procedures of MTP 2-2-612.

6.3.20

Towed or Manually Propelled Ground Support Equipment Mobility Tests

6.3.20.1

Parking Brake Test

Record the following:

- a. Force in pounds applied to test item with parking brake set.
- b. Evidence that test item wheels containing the parking brakes rolled or skidded.

- c. Whether or not test item parking brake held on incline.
- d. Incline, in percent.

6.3.20.2

Service Brake Test

Record the following:

- a. Vehicle combination speed, in miles per hour.
- b. Time(s) at which towing vehicle brake was depressed.
- c. Deceleration recording traces synchronized to brake pedal actuation(s).
- d. Towing speeds, in miles per hour.
- e. Notations on recording charts for correlation purposes.

6.3.20.3

Improved Level Surfaces Mobility Test

Record the following:

- a. Details of test course, obstruction height and interval separating each obstruction.
- b. Pintle height of towing vehicle.
- c. Towing speed, in miles per hour.
- d. Number of right and left circle turn completed.
- e. Force required to tow test item over level surface, no obstructions, in pounds.
- f. Force required to tow test item over obstruction course, in pounds.
- g. Evidence of damage to test item running gear following test.
- h. Data of applicable performance tests.

6.3.20.4

Partially Improved Terrain Mobility Test

Record the following:

- a. Type of towing vehicle used.
- b. Towing speed over level highway, in miles per hour.

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- c. Distance towed, level highway, in miles.
- d. Towing speed over graded, gravel roads, in miles per hour.
- e. Distance towed, gravel roads, in miles.
- f. Evidence of damage to test item running gear following test.
- g. Data required by appropriate performance test(s).

6.3.21 Broadband Radio Interference Tests

Record the data required by applicable tests of MTP 2-2-613 and applicable qualification tests of MIL-STD-461 and MIL-STD-462.

6.3.22 Vibration and Shock Tests

Record data required by applicable procedures of MIL-E-4970 Procedure IV-Category A equipment. Also, applicable data required by MIL-STD-705.

6.3.23 Climatic Extremes Tests

Record data required by applicable procedures of MTP's 2-4-001, 2-4-002 and 2-4-003.

6.3.24 Intermediate Climatic Tests

6.3.24.1 Rain Test

Record the following:

- a. Type of rain course, i.e., natural, simulated.
- b. Rain rate, in gallons per minute.
- c. Exposure schedule and exposure times.
- d. Evidence of the following:
  - 1) Water in air-intake filter.
  - 2) Water in sump, fuel tank, or hydraulic reservoir, etc.

6.3.24.2 Low Temperature Test (all test item types)

Record the following:

- a. Stabilized low temperature, in degrees F.



- b. Length of time required to start cold prime mover engine.
- c. Following test:
  - 1) Differential contraction of metal parts.
  - 2) Loss of resiliency of packings and gaskets.
  - 3) Congealing of lubricants.
- d. Other effects of cold climatic conditions on test item

types.

6.3.24.3 Air Compressor Low Temperature Test

Record data required by Method 502, Procedure I, of MIL-STD-810 with a 100% capacity flow nozzle installed.

6.3.24.4 Ground Blower Heater Low Temperature Test

Record the following:

a. Data required by 6.2.1 Heat Output Test (test item input conditions altered).

b. Effect of cold climate on heater output.

6.3.24.5 Auxiliary Power Unit Low Temperature Test

Record data required by MIL-STD-705, Methods: 701.b, 701.2b, 701.4a, and 702.1a.

6.3.24.6 High Temperature Tests (all test item types)

Record the following:

a. Stabilized temperature values, in degrees F.

b. Evidence of damage due to high temperatures, including the following:

- 1) Permanent set of packings or gaskets.
- 2) Binding of parts in equipment of complex construction.
- 3) Rubber, plastic, and/or plywood parts which discolored, cracked, bulged, or crazed.
- 4) Closure and sealing strips which became gummy or stuck to contracting parts.

6.3.24.7 Air Compressor High Temperature Test

Record the following:

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a. Data required by Method 501, Procedure I, MIL-STD-810B.  
with a 100% capacity flow nozzle installed.

b. Length of time test item was exposed to high temperature.

c. Engine coolant temperature, in degrees F.

d. Engine lubricating oil temperature in degrees F.

e. Data required by item d of 6.2.2.1 Rated Capacity Test.

6.3.24.8 Ground Blower Heater High Temperature Test

Record the following:

a. Data required by 6.2.1.1 Heat Output Test, altered for  
high temperature test.

b. Evidence of altered performance due to high temperatures.

6.3.24.9 Auxiliary Power Unit High Temperature Test

Record the data required by applicable procedures of MIL-  
STD-705, Method 710.1b.

6.3.25 Salt Fog Test

Record the following:

a. Data required by applicable procedures of MIL-STD-810B.

b. Following the test:

- 1) Evidence of metal corrosion.
- 2) Evidence of test item moving parts which became  
clogged from salt deposits.

6.3.26 Sand and Dust Test

Record the following:

a. Data required by applicable procedures of MIL-STD-810B.

b. Evidence of the following:

- 1) Abrasion to test item moving parts.
- 2) Test item finish damage.
- 3) Test item parts which bound due to sand or dust.
- 4) Interference of test item with electrical contacts.

6.3.27      Altitude Test

Data required by applicable procedures of Method 500, MIL-STD-810, Procedure I.

6.3.28      Transportability

Record the following:

a. Rail test, loading:

- 1) Equipment used for loading.
- 2) Difficulties encountered during loading operations.
- 3) Materials description used for securing, etc.
- 4) Location of accelerometer sensors.

b. Rail test, operation:

- 1) Speed prior to abrupt stop.
- 2) Accelerometer shock-vibration recording charts.
- 3) Damage incurred by the test item, including packing material.

c. Rail test, humped:

- 1) Speed at which the "humped couplings" were made.
- 2) Flatcar weight, etc.
- 3) Accelerometer sensor recordings.
- 4) Buffer-device movements.
- 5) Damage to test item or packaging material.

d. Rail test, clearance:

- 1) Overhang/restrictions encountered. Include all available information.
- 2) Test item disassembly required for clearance.
- 3) Time to disassemble etc., if applicable.

e. Rail test, unloading:

- 1) Materials handling equipment (MHE) used during unloading.
- 2) Difficulties encountered during unloading.

f. Tractor damage discovered during inspection(s) following rail test(s).

g. Vehicle transport, loading:

- 1) Type of transport vehicle.

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- 2) MHE used during loading.
- 3) Method and materials used for securing test item.
- 4) Difficulties encountered during loading operation.

h. Marine transport, rough transit:

- 1) Sea state.
- 2) Wind speed and direction.
- 3) Recording accelerometer readings/charts.
- 4) Damage to test item or bracing.

i. Marine transport, rough transit simulation:

- 1) Roll, in degrees.
- 2) Roll period, in seconds.
- 3) Pitch, in degrees.
- 4) Pitch period, in seconds.

j. Data required by conduct of evaluations from MPT's 7-2-509 and 7-2-510, as applicable.

6.3.29 Maintenance and Reliability Evaluation

Record the following:

- a. Data required by applicable procedures of MTP 10-2-507.
- b. Adequacy of:
  - 1) Tools.
  - 2) Repair parts.
  - 3) Test and handling equipment.
  - 4) Maintainability.
  - 5) Availability.

6.3.30 Safety

Record the following:

- a. Data required by applicable procedures of MTP 2-2-508.
- b. Adequacy of heater blower construction to withstand effects of internal explosion.
- c. Probability of personnel being injured during normal operation of heater blower during internal explosions.
- d. Any other dangerous or unsafe condition that might present a safety hazard.

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- e. Safety features incorporated into test item design.
- f. Adequacy of warning instructions and markings.
- g. Suggestions to improve the existing safety precautions.

6.3.31 Human Factors Evaluation

Record the following:

- a. Data required by applicable procedures of MTP 2-2-803.
- b. Checklists.
- c. Noted inadequacies of test item design affecting ease of test item operation.
- d. Recommendations to improve man-item effectiveness.

6.3.32 Value Analysis

Record the following:

- a. Nonfunctional, costly, or "nice-to-have" features of the test item.
- b. Test personnel comments and opinions regarding features to be eliminated.

6.3.33 Quality Assurance

Record:

- a. Data required by MTP 10-2-511.
- b. Comments as to any design shortcomings in the area of required quality.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Rated Capacity

Calculate the volumetric rate at flow using the following equation:

$$Q_a = \frac{2.552 C D_n^2 T_1}{P_a} \sqrt{\frac{P_b P}{T_2}}$$

where

$Q_a$  = volumetric rate of flow (cubic feet per minute).

$T_1$  = Absolute temperature at compressor intake ( $^{\circ}\text{F.} + 459.7$ ).  
(average temperature taken at three points at the engine crankshaft height, 3 to 5 feet from the compressor).

$P_a$  = Absolute pressure at compressor intake, pounds per square inch absolute (psia).

$C$  = Nozzle coefficient of discharge.

$D_n$  = Nozzle throat diameter (inches).

$P_b$  = Barometric pressure, corrected (inches of mercury).

$T_2$  = Absolute temperature, upstream of the nozzle ( $^{\circ}\text{F.} + 459.7$ ).

$P$  = Differential pressure across the nozzle (inches of water column).

#### 6.4.2 Safety

Present the safety release data in accordance with USATECOM Regulation 385-6.

#### 6.4.3 Human Factors

Present an analysis of human factors design features which do not conform to recognized human factors design criteria; including steady state noise and blowdown noise, when applicable.

#### 6.4.4 General Presentation

All data obtained during conduct of the engineering tests shall be summarized, making use of curves, charts, photographs, or other graphic materials, as appropriate.

#### 6.4.5 Analysis

Data obtained for each test item performance characteristics shall be compared with technical performance characteristics specified in applicable MN or other developmental criteria. Recommendations should be provided in regard to the test item(s) suitability for service testing.